4.2.6.2 Data Requirements and Data Gaps

The likely extent of debris will be determined through review of the existing detailed 2011 bathymetry, the 2008 and 2011 side scan sonar surveys, drawings, photos, and other historical information. This review process will evaluate the following information:

- Debris material type (e.g., wood, brick, concrete, rock, metal, and vegetation)
- Debris size (e.g., length, width, and height above mudline)
- Debris embedment depth
- Debris relative shape and porosity (e.g., solid versus open structure)
- Mapping of abandoned pilings extending above the mudline and general condition (degree of weathering)

If deemed to be warranted based on the existing document review, additional debris characterization may be proposed using geophysical surveying methods (e.g., side-scan sonar and magnetometer surveys). The material type, approximate size, shape, and porosity of debris may also be further characterized by visual inspection of underwater video based on evaluation of the current identified debris in the Final Project Area.

4.2.7 Element 5—Slope Stability

Both the USACE (Palermo et al. 1998a) and EPA (Palermo et al. 1998b) guidance documents state that geotechnical considerations are important in capping because most contaminated sediments are fine-grained silts and clays. Fine-grained silts and clays are generally lower strength materials that are potentially susceptible to sliding slope failures following cap placement. A portion of the Final Project Area has fine-grained material, although the majority of the Final Project Area is coarser-grained sands. Proper assessment of the stability of slopes to support a cap is a critical geotechnical component in a cap design (Palermo et al. 1998a, 1998b; EPA 2005; ITRC 2014). Stable cap construction has been successfully completed at numerous sites, including sites within the Portland Harbor (e.g., Gasco Tar Body Early Action, McCormick and Baxter, and the Port of Portland's Terminal 4). The cap construction implemented at these sites, which followed appropriate slope stability design measures outlined in the capping guidance documents, provide useful precedents for potential slope stability performance standards.

The proposed performance standards for demonstrations of slope stability are as follows (Palermo et al. 1998b):

- Demonstrate the cap and slope will be stable after placement on slopes. Computed slope stability factors of safety with the placed cap shall meet the slope criteria established by USACE (2003).

4.2.7.1 Method of Analysis

Guidance for cap slope stability analysis methodologies are outlined in Appendix C of Palermo et al. (1998b). The first task is to select representative cross-sections of slope areas where capping is being evaluated at the Final Project Area. The cross-sections will be selected for representative conditions as well as steeper slopes. Slope stability will be evaluated using Rocscience SLIDE 6.0 computer software. The geometry and stratigraphy of existing or proposed slopes and associated corresponding soil and water parameters (e.g., groundwater elevations, river stage elevation, soil strength model, soil density, and soil strength) will be used as inputs, and trial runs will be conducted to locate the "critical" failure surface—that is, the failure surface with the lowest factor of safety (FOS). The software uses limit equilibrium methods to calculate stresses (loads) and strength (resistance) for each slip surface evaluated. The FOS is computed using methods that satisfy both force and moment equilibrium for the failure surface. The computed factors of safety for all failure surfaces will need to exceed the established performance standard FOS (presented in USACE 2003). If the lowest FOS is above the performance standard, then the proposed cap section should be stable. If there are any factors of safety below the performance standard, then the geometry of the slope and/or cap section need to be adjusted accordingly.

4.2.7.2 Data Requirements and Data Gaps

The following data will be needed to support the slope stability design calculations:

- Bathymetry and topography of the areas to be capped are available and will be used to determine existing slope configurations.
- Slope configurations for cap areas after partial dredging will be determined based on the design dredge prisms in those same areas, as necessary.
- The unit weight, groundwater levels, and strengths of existing sediments or soils within the cap areas will be based on existing and/or additional collected geotechnical explorations conducted in the cap areas.
- The unit weight and strength of cap materials will be estimated using standard references (FHWA 1997) applicable to the cap material that is expected to be used (e.g., upland quarry sand).
- Willamette River levels will be established based on statistical analysis of historical data. A sensitivity analysis will be completed on these water levels to evaluate the impact of river level on slope stability.

Of these data requirements, NW Natural will review the existing geotechnical data within proposed cap areas and determine if additional data is necessary to support remedial design.